PROJECT DATA

S. Katz Associates, Inc. - 01GO11034

Cupola Furnace Computer Process Model

Recipient:	S. Katz Associates, Inc.	Instrument Number:	DE-FG36-01GO11034
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Subcontractor(s):		B & R Number(s):	ED1906020
		PES Number(s):	01-2031
EERE Program:	Industrial Technologies	State Congressional District:	MI - 11

PROJECT SCOPE: The goal of this project is to further develop a computer process model (the Cupola model) that integrates scrap metal process variables to accurately predict furnace output based on given inputs. The work involves model revisions, experimental studies, and market development. The innovation is expected to optimize operations and reduce energy consumption (potential 2.3 x 10^{13} Btu/yr) and greenhouse gas emissions (potential 1.7 x 10^{6} tons/yr).

FINANCIAL ASSISTANCE

Approved DOE Budget	$258,000	Approved DOE Share	$258,000
Obligated Doe Funds	$258,000	Cost Share	$277,148
Remaining Obligation	$0		
Unpaid Balance	$19,932	**TOTAL PROJECT**	**$535,148**

Project Period: 7/15/01-6/30/04

$58,000 of the Approved DOE Share is from the Industrial Technologies (Steel) Program

TECHNICAL PERFORMANCE

DE-FG36-01GO11034

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PROJECT SYNOPSIS

The goal of this grant is to bring to commercialization a computer process model of the Cupola furnace. The model will serve to optimize Cupola operations in real-time with respect to cost and quality of the iron produced and reductions in hazardous emissions. The model will also enable accurate cost/benefit analyses for major furnace modifications that will reduce energy consumption and further optimize operations.

SUMMARY OF TECHNICAL PROGRESS

The goal to develop an accurate and easy-to-use computer process model of the Cupola furnace was divided into two parts – development of algorithms that mathematically describe Cupola operation and the development of a user-friendly graphic user interface (GUI). Both of these programs have been completed.

With respect to the development of algorithms, the last phase of work concentrated on fine tuning the model. To facilitate fine tuning, a series of tuning variables were added to the model. This allows small adjustments to be made to increase the accuracy of the predictions. Tailoring the model to the performance of a particular Cupola requires the availability of operational data taken under well-characterized conditions. Other improvements to existing algorithms were also made. Although the possible additions to a computer model are never complete, the current product will serve the iron foundries very well.

The graphic user interface is now complete. A detailed user's manual has been written and a few minor changes have been made to some of the screens.

Another goal of this grant is to develop improved algorithms to predict the performance of silicon carbide. Silicon carbide is a common Cupola additive. It is used to simultaneously raise the silicon and carbon concentrations in liquid iron to desired levels. This study was made necessary because, unlike all the metal constituents added to the Cupola, silicon carbide does not melt (it dissolves). As a result, the algorithms that apply to constituents that melt in the Cupola do not apply to silicon carbide. An adequate algorithm exists, but a more refined one was desired. This work has also been completed.

While nearing the end of the program, attention focused on advertising the model and the development of a marketing strategy. Toward this end, several presentations were made at Cupola conferences and preparations are being made to produce articles for foundry trade magazines.

SUMMARY OF PLANNED WORK

The final work at the University of Antioquia will consist of quenching their Cupola while in full operation and then measuring and studying the contents of the Cupola using archeological techniques. This work will be completed by 06/30/04.

PROJECT ANALYSIS

The project encountered several problems that caused significant delays in the schedule, but it appears that the work will be completed by 06/30/04, which is the current end date for the grant. Katz had significant problems with some of the project participants, including major overruns and lack of progress that led to the eventual termination of some of the tasks. These tasks were not critical, however, and a working Cupola model was eventually developed. The model is still virtually unproven in a commercial setting and its benefits have not been substantiated by an independent third party or commercial foundry. The project definitely needs more future work before it would be considered an emerging technology.

ACTION REQUIRED BY DOE HEADQUARTERS

No action is required from DOE Headquarters at this time.

STATEMENT OF WORK
DE-FG36-01GO11034
S. Katz Associates, Inc.
Cupola furnace Computer Process Model

Detailed Task Description

Task 1. Add Radiant Heat Transfer to the Model

Radiant heat transfer will be added to the model. Inclusion is seen as critical to improvement of the prediction of iron temperature.

Task 2. Model Testing & Corrections

The database of accurate cupola input/output data, suitable for examining model accuracy, will be expanded. Any uncovered weaknesses will be corrected.

Task 3. SiC Cupola Studies

Improved algorithms describing SiC performance will be developed through cupola and laboratory studies. Materials removed from the interior of an experimental cupola will provide information on where and how SiC reacts.

Task 4. SiC Laboratory Studies

Laboratory kinetics studies will provide needed reaction rate information.

Task 5. Improved Cupola-Well Model

Much of the alloy loss and carbon dissolution takes place in the cupola-well region. The current model is over-simplistic and does not properly consider the affect of slag basicity and iron sulfur level on alloy loss and carbon dissolution. The model will be amended using existing cupola data.

Task 6. Enhanced Graphic User Interface

Develop a much more user-friendly graphic user interface to greatly simplify the use of the model. The plan is to operate the model from a central control screen from which the inputs can be easily selected, run instructions can be given, and the outputs viewed. Another enhancement that will be added is the critical calculation of the blast rate from cupola operating data.

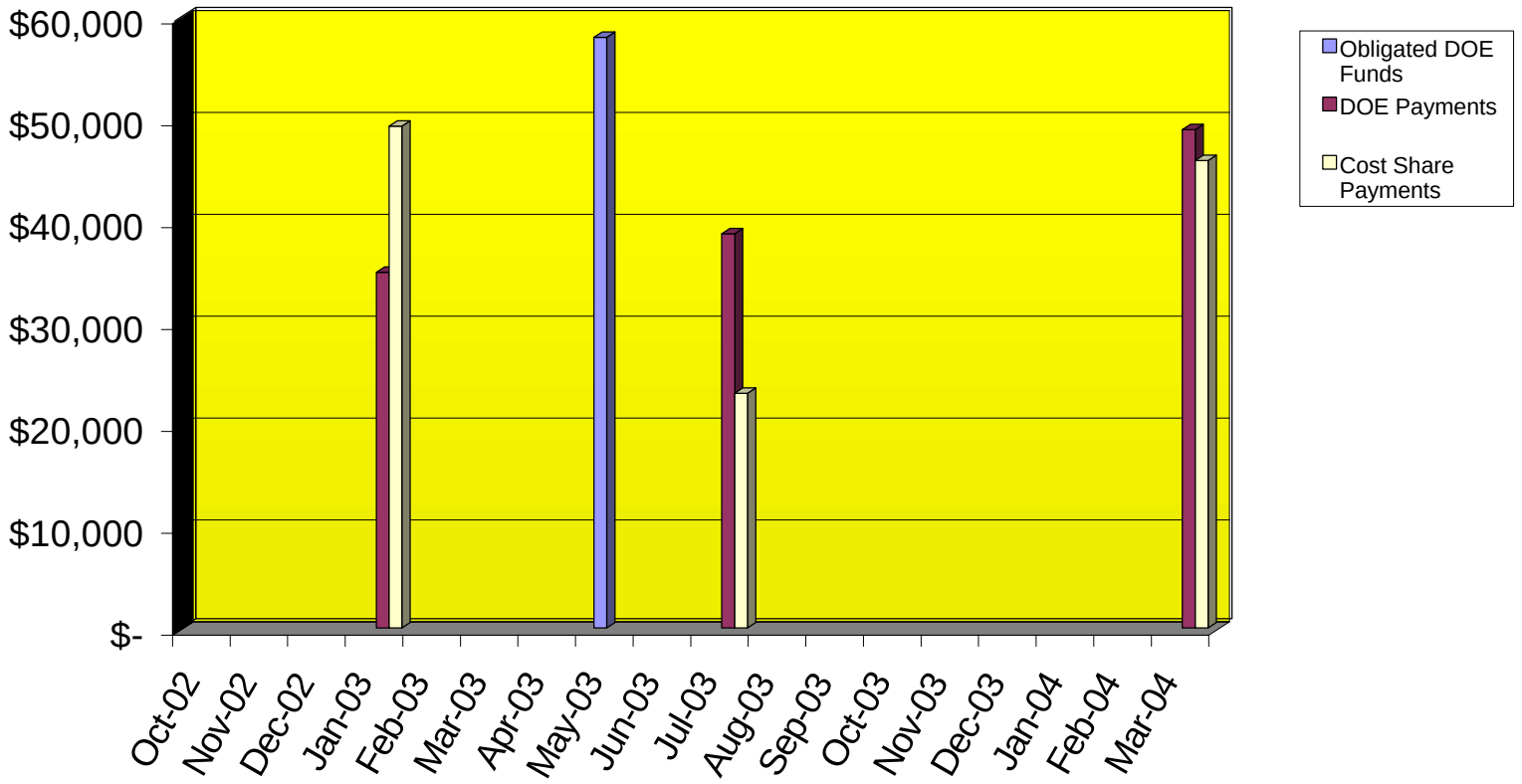
Task 7. Cupola Model Marketing Efforts

Work with mentor to develop marketing strategies and proper sale price for the model and ancillary services. Develop a team to provide needed services and future improvements to model.

Project Cost Performance in DOE Dollars for Fiscal Year 2003

DE-FG36-01GO11034 **S. Katz Associates, Inc.**

Cupola Furnace Computer Process Model



	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03
Obligated DOE Funds	$0	$0	$0	$0	$0	$0	$0	$58,000	$0	$0	$0	$0
DOE Payment	$0	$0	$0	$34,912	$38,719	$48,917	$0	$0	$0	$0	$0	$0
Cost Share Payment	$0	$0	$0	$49,276	$0	$0	$0	$0	$0	$23,038	$0	$0

	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04	PFY*	Cumulative
Obligated DOE Funds	$0	$0	$0	$0	$0	$0	$200,000	$258,000
DOE Payment	$0	$0	$0	$0	$0	$0	$115,521	$238,068
Cost Share Payment	$0	$0	$0	$0	$0	$45,909	$153,852	$272,076

Approved DOE Budget:	$258,000
Approved Cost Share Budget:	$277,148
Total Project Budget:	$535,148

* Prior Fiscal Years

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Task Name	Start	Finish
Task 1. Radiant Heat Transfer	Wed 8/15/01	Fri 11/30/01
Task 2. Model Testing	Fri 11/30/01	Fri 2/15/02
Task 3. SiC - cupola studies	Mon 6/17/02	Mon 12/30/02
Task 4. SoC Laboratory Studies	Mon 6/17/02	Wed 6/30/04
Task 5. Marketing efforts	Mon 7/15/02	Wed 6/30/04
Task 6. Enhanced GUI	Wed 9/5/01	Wed 9/5/01
Task 7. Project Management and Submit Final Technical and Financial Status Reports	Tue 10/15/02	Wed 6/30/04